MIZORAM PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF
INSPECTOR OF LEGAL METROLOGY UNDER FOOD, CIVIL SUPPLIES & CONSUMER AFFAIRS
DEPARTMENT, GOVERNMENT OF MIZORAM, DECEMBER, 2018

MECHANICAL ENGINEERING
PAPER - II

Time Allowed : 2 hours   Full Marks : 200

All questions carry equal marks of two (2) each.
Attempt all questions.

1. The type of pair formed by two elements which are so connected that one is constrained to turn or revolve about a fixed axis of another element is known as
   (a) turning pair
   (b) rolling pair
   (c) sliding pair
   (d) spherical pair

2. Pitch point on a cam is
   (a) any point on pitch curve
   (b) the point on cam pitch curve having the maximum pressure angle
   (c) any point on pitch circle
   (d) the point on cam pitch curve having the minimum pressure angle

3. If some links are connected such that motion between them can take place in more than one direction, it is called
   (a) incompletely constrained motion
   (b) partially constrained motion
   (c) completely constrained motion
   (d) successfully constrained motion

4. Kinematic pairs are those which have two elements that
   (a) have line contact
   (b) have surface contact
   (c) permit relative motion
   (d) are held together

5. In higher pair, the relative motion is
   (a) purely rotary
   (b) purely sliding
   (c) purely turning
   (d) combination of sliding and turning

6. Relationship between the number of links (L) and number of pairs (P) is
   (a) $P = 2L-4$
   (b) $P = 2L + 4$
   (c) $P = 2L+2$
   (d) $P = 2L-2$

7. A mechanism where there are no restrictions on the relative motion between the particles, the mechanism is called
   (a) Planar mechanism
   (b) Flexure mechanism
   (c) Spherical mechanism
   (d) Spatial mechanism

8. What is the equation for Grubler's criterion for plane mechanisms with constrained motion?
   (a) $3n-2j_1-4=0$
   (b) $3n-3j_1-4=0$
   (c) $3n+2j_1+4=0$
   (d) $3n+3j_1+4=0$

9. A higher pair has_____.
   - (a) Point contact
   - (b) Surface contact
   - (c) No contact
   - (d) None of these

10. State the three-dimensional form of Kutzbach criterion.
    - (a) $6(n-1) +5j_1+4j_2+3j_3+2j_4+j_5$
    - (b) $6(n-1) -5j_1-4j_2-3j_3-2j_4-j_5$
    - (c) $6(n+1) +5j_1+4j_2+3j_3+2j_4+j_5$
    - (d) $6(n+1) -5j_1-4j_2-3j_3-2j_4-j_5$

11. Which gear is used for connecting two coplanar and intersecting shafts?
    - (a) Spur gear
    - (b) Helical gear
    - (c) Bevel gear
    - (d) None of these

12. A fixed gear having 200 teeth is in mesh with another gear having 50 teeth. The two gears are connected by an arm. The number of turns made by the smaller gear for one revolution of arm about the centre of bigger gear is
    - (a) 2
    - (b) 4
    - (c) 3
    - (d) None of these

13. The number of inversions for a slider crank mechanism is
    - (a) 6
    - (b) 5
    - (c) 4
    - (d) 3

14. Any point on a link connecting double slider crank chain will trace a
    - (a) Straight line
    - (b) Circle
    - (c) Ellipse
    - (d) Parabola

15. A universal joint is an example of
    - (a) Higher pair
    - (b) Lower pair
    - (c) Rolling pair
    - (d) Sliding pair

16. Which gear train is used for higher velocity ratios in a small space?
    - (a) Simple gear train
    - (b) Compound gear train
    - (c) Reverted gear train
    - (d) Epicyclic gear train

17. When the sleeve of a porter governor moves upwards, the governor speed
    - (a) Increases
    - (b) Decreases
    - (c) Remains unaffected
    - (d) First increases and then decreases

18. Idler pulley is used
    - (a) for changing the direction of motion of the belt
    - (b) for applying tension
    - (c) for increasing -velocity ratio
    - (d) all of these

19. Creep in belt drive is due to
    - (a) material of the pulley
    - (b) material of the belt
    - (c) larger size of the driver pulley
    - (d) uneven extensions and contractions due to varying tension

20. Typewriter constitutes
    - (a) machine
    - (b) structure
    - (c) mechanism
    - (d) inversion

21. The connection between the piston and cylinder in a reciprocating engine corresponding to
    - (a) completely constrained kinematic pair
    - (b) incompletely constrained kinematic pair
    - (c) successfully constrained kinematic pair
    - (d) single link

22. The minimum number of links in a single degree-of-freedom planar mechanism with both higher and lower kinematic pairs is

    (a) 2   (b) 3

    (c) 4   (d) 5

23. In a Kinematic chain, a quaternary joint is equivalent to:

    (a) One binary joint   (b) Two binary joints

    (c) Three binary joints   (d) Four binary joints

24. For a governor running at constant speed, what is the value of the force acting on the sleeve?

    (a) Zero   (b) Variable depending upon the load

    (c) Maximum   (d) Minimum

25. The height of Watt's governor is

    (a) directly proportional to the speed   (b) directly proportional to the $(\text{speed})^2$

    (c) inversely proportional to the speed   (d) inversely proportional to the $(\text{speed})^2$

26. Which one of the following governors is used to drive a gramophone?

    (a) Watt governor   (b) Porter governor

    (c) Pickering governor   (d) Hartnell governor

27. A system in dynamic balance implies that

    (a) the system is critically damped   (b) there is no critical speed in the system

    (c) the system is also statically balanced   (d) there will be absolutely no wear of bearings

28. Two rotors are mounted on a shaft. If the unbalanced force due to one rotor is equal in magnitude to the unbalanced force due to the other rotor, but positioned exactly 180° apart, then the system will be balanced

    (a) statically   (b) dynamically

    (c) statically as well as dynamically   (d) neither statically nor dynamically

29. The cam follower generally used in automobile engines is

    (a) Knife edge follower   (b) Flat faced follower

    (c) Spherical faced follower   (d) Roller follower

30. Off set is provided to a cam follower mechanism to

    (a) Minimise the side thrust   (b) Accelerate

    (c) Avoid jerk   (d) None of these

31. When the driving torque is more than load torque, flywheel is _____

    (a) Accelerated   (b) Decelerated

    (c) Constant velocity   (d) Can't be determined

32. Which of the following factors are not responsible for unbalancing in rotating systems?

    (a) Errors   (b) Tolerances

    (c) Shape of the rotor   (d) None of these

33. The secondary unbalanced force is _____ the primary unbalanced force.

    (a) One-half   (b) Two-third

    (c) Times   (d) $1/n$ times

34. In under damped vibrating system, the amplitude of vibration

    (a) Decreases linearly with time   (b) Increases linearly with time

    (c) Decreases exponentially with time   (d) Increases exponentially with time

35. Torsional vibrations are said to occur when the particles of a body moves

    (a) Perpendicular to its axis   (b) Parallel to its axis

    (c) In a circle about its axis   (d) None of these

36. When _____ occurs below a critical power input the gas bubbles are not affected laterally but move upward.

    (a) Weeping   (b) Flooding

    (c) Mixing   (d) Entrainment

37. The critical speed of a rotating shaft depends upon

    (a) Mass   (b) Stiffness

    (c) Mass and Stiffness   (d) Mass, Stiffness and eccentricity

38. Cotter joint is used when the members are subjected to which type of stresses?

    (a) Axial tensile   (b) Axial compressive

    (c) Axial tensile or compressive   (d) None of these

39. Which of the following is not a part of cotter joint?

    (a) Socket   (b) Spigot

    (c) Cotter   (d) Collar

40. Determine the width of the cotter used in cotter joint connecting two rods subjected to axial load of 50 kN and permissible shear stress in cotter is 50 N/mm^2. given thickness of cotter is 10 mm.

    (a) 50 mm   (b) 100 mm

    (c) 150 mm   (d) 25 mm

41. A sunk key fits in the keyway of the _____ only

    (a) Hub   (b) Sleeve

    (c) Both hub and sleeve   (d) Neither hub nor sleeve

42. The main advantage of sunk key is that it is a _____ drive.

    (a) Positive   (b) Negative

    (c) neutral   (d) Can't predict

43. Involute splines have stub teeth with a pressure angle of

    (a) 30   (b) 45

    (c) 60   (d) Can't be determined

44. The pitch of threads on a lock nut in comparison to pitch of nut is

    (a) Same   (b) Coarser

    (c) Finer   (d) Very coarse

45. Buttress threads are usually found on

    (a) Screw cutting lathes   (b) Feed mechanism

    (c) Splines of bench vice   (d) Railway carriage couplings

46. For tight leakage joints, the following type of thread is best suited

    (a) Metric   (b) Buttress

    (c) Square   (d) NPT (national pipe thread)

47. Belt slip may occur due to

    (a) Heavy load   (b) Loose belt

    (c) Driving pulley too small   (d) All of these

48. Which one of the following causes the whirling of shafts?
    (a) Non-homogeneity of shaft material
    (b) Misalignment of bearings
    (c) Fluctuation of speed
    (d) Internal damping

49. The size of a gear is usually specified by
    (a) pressure angle
    (b) circular pitch
    (c) diametral pitch
    (d) pitch circle diameter

50. Stress concentration in static loading is more serious in
    (a) ductile materials
    (b) brittle materials
    (c) equally serious in both cases
    (d) depends on other factors

51. In a gib and cotter joint, the gib and cotter are subjected to
    (a) single shear only
    (b) double shear only
    (c) single shear and crushing
    (d) double shear and crushing

52. A key connecting a flange coupling to a shaft is likely to fail in
    (a) shear
    (b) tension
    (c) torsion
    (d) bending

53. Which one of the following is not a friction clutch?
    (a) Disc or plate clutch
    (b) Cone clutch
    (c) Centrifugal clutch
    (d) Jaw clutch

54. The creep in a belt drive is due to the
    (a) material of the pulleys
    (b) material of the belt
    (c) unequal size of the pulleys
    (d) unequal tension on tight and slack sides of the belt

55. Centrifugal tension in belts is
    (a) useful because it maintains some tension even when no power is transmitted
    (b) not harmful because it does not take part in power transmission
    (c) harmful because it increases belt tension and reduces the power transmitted
    (d) a hypothetical phenomenon and does not actually exist in belts

56. The velocity ratio between pinion and gear in a gear drive is 2.3, the module of teeth is 2.0 mm and sum of number of teeth on pinion and gear is 99. What is the centre distance between pinion and the gear?
    (a) 49.5 mm
    (b) 99 mm
    (c) 148.5 mm
    (d) 198 mm

57. Which type of gear is used for shaft axes having an offset?
    (a) Mitre gears
    (b) Spiral bevel gears
    (c) Hypoid gears
    (d) Zerol gears

58. There are six gears A, B, C, D, E, F in a compound train. The numbers of teeth in the gears are 20, 60, 30, 80, 25 and 75 respectively. The ratio of the angular speeds of the driven (F) to the driver (A) of the drive is
    (a) 1/24
    (b) 1/8
    (c) 4/15
    (d) 12

59. In the compound gear train shown in the figure below, gears A and C have equal numbers of teeth and gears B and D have equal numbers of teeth. When A rotates at 800 rpm, D rotates at 200 rpm. The rotational speed of compound gears BC would then be
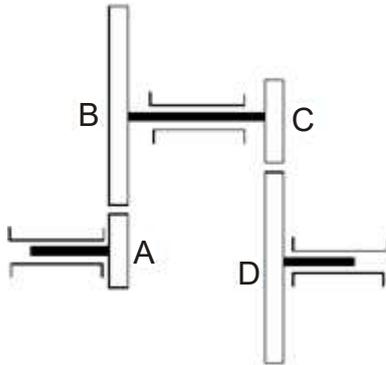
    (a) 300 rpm   (b) 400rpm
    (c) 500 rpm   (d) 600rpm

60. In sliding contact bearings, a positive pressure can be built up and a loadsupported by a fluid only by the use of a:

    (a) Diverging film   (b) Converging-diverging film
    (c) Converging film   (d) Flat film

61. The rolling element bearings are

    (a) Hydrostatic bearings   (b) Squeeze film bearings
    (c) Antifriction bearings   (d) Grease lubrication bearings

62. In V belt drive, the belt touches

    (a) At the bottom   (b) At sides only
    (c) Could touch anywhere   (d) None of the above

63. The following is not a friction clutch

    (a) Centrifugal clutch   (b) Cone clutch
    (c) Disc clutch   (d) Fluid clutch

64. The gears used to connect non-parallel non-intersecting shafts is

    (a) Straight bevel gear   (b) Spiral bevel gear
    (c) Spiral gear   (d) Double helical gear

65. Calculate the speed of driving shaft in compound gear train, if the drivers have 50, 60, 80 and 100 teeth and follower have 18, 40, 60 and 80 teeth. Speed of driven shaft is 150 rpm

    (a) 21.73 rpm   (b) 30.23 rpm
    (c) 19.77 rpm   (d) Data insufficient

66. Two gears are said to have conjugate motion if

    (a) They have constant angular velocity   (b) Variable angular velocity
    (c) Infinitely small angular velocity   (d) None of the mentioned

67. Herringbone gear can be used in

    (a) Intersecting shafts only   (b) Parallel shafts only
    (c) Both intersecting and parallel shafts   (d) None of the mentioned

68. Which of the following is true for worm gears?

    (a) Worm is in the shape of threaded screw   (b) Worm imposes high thrust loads
    (c) Threads on the worm have small lead   (d) Characterized by low speed reduction ratio

69. A journal of 120 mm diameter rotates in a bearing at a speed of 1000 rpm. What is the power lost during friction if 8 kN radial load acts on the journal and co-efficient of friction is 2.525×10^{-3}?

    (a) 7.615 kW   (b) 0.253 kW

    (c) 0.126 kW   (d) 2.365 kW

70. Thick film lubrication describes a phenomenon where two surfaces are _____ separated

    (a) Completely   (b) Partially

    (c) Not   (d) None of the mentioned

71. If we exclude the cost factor, which bearing is preferred?

    (a) Hydrodynamic   (b) Both are equally preferred

    (c) Hydrostatic   (d) Cannot be determined

72. Where is the necking region?

    (a) Area between lower yield point and upper yield point

    (b) Area between plastic limit and elastic limit

    (c) Area between ultimate point and initial point

    (d) Area between the ultimate point and rupture

73. Eccentrically loaded structures have to be designed for

    (a) Uniaxial force   (b) Biaxial force

    (c) Combined axial force   (d) Combined biaxial force

74. _____ is as the maximum energy that can be absorbed within the proportionality limit.

    (a) Proof resilience   (b) Modulus of resilience

    (c) Impact resilience   (d) Resilience

75. In Mohr's circle of strain, y-axis represents.

    (a) Shear strain   (b) Half of shear strain

    (c) Normal strain   (d) Half of normal strain

76. If the value of Poisson's ratio is zero, then it means that

    (a) The material is rigid   (b) The material is perfectly plastic

    (c) There is no longitudinal strain in the material   (d) The longitudinal strain in the material is infinite

77. The highest stress that a material can withstand for a specified length of timewithout excessive deformation is called

    (a) Fatigue strength   (b) Endurance strength

    (c) Creep strength   (d) Creep rupture strength

78. In a body, thermal stress is induced because of the existence of:

    (a) Latent heat   (b) Total heat

    (c) Temperature gradient   (d) Specific heat

79. Which one of the following properties is more sensitive to increase in strain rate?

    (a) Yield strength   (b) Proportional limit

    (c) Elastic limit   (d) Tensile strength

80. A block of steel is loaded by a tangential force on its top surface while the bottom surface is held rigidly. The deformation of the block is due to

    (a) Shear only   (b) Bending only

    (c) Shear and bending   (d) Torsion

81. The number of components in a stress tensor defining stress at a point in three dimensions is:

(a) 3   (b) 4

(c) 6   (d) 9

82. If principal stresses in a two-dimensional case are –10 MPa and 20 MPa respectively, then maximum shear stress at the point is

(a) 10 MPa   (b) 15 MPa

(c) 20 MPa   (d) 30 MPa

83. The bending moment (M) is constant over a length segment (I) of a beam. The shearing force will also be constant over this length and is given by

(a) M/I   (b) M/2I

(c) M/4I   (d) None of these

84. The maximum bending moment in a simply supported beam of length L loaded by a concentrated load W at the midpoint is given by

(a) WL   (b) WL/2

(c) WL/4   (d) WL/8

85. A beam simply supported at equal distance from the ends carries equal loads at each end. Which of the following statements is true?

(a) The bending moment is minimum at the mid-span

(b) The bending moment is minimum at the support

(c) The bending moment varies gradually between the supports

(d) The bending moment is uniform between the supports

86. Which one of the following is the correct statement? If for a beam $dM/dx = 0$ for its whole length, the beam is a cantilever:

(a) Free from any load

(b) Subjected to a concentrated load at its free end

(c) Subjected to an end moment

(d) Subjected to a udl over its whole span

87. Principal planes are those planes on which

(a) Normal stress is maximum   (b) Normal stress is minimum

(c) Normal stress is either maximum or minimum   (d) Shear stress is maximum

88. Resilience can also be termed as

(a) Stress energy   (b) Strain energy

(c) Modulus   (d) Tenacity

89. Which of the following methods is also known as individual wall method?

(a) Centre line method   (b) Alignment method

(c) Long wall and short wall method   (d) Voluminous method

90. The ductility of a material is _____ to the increase in percentage reduction in an area.

(a) inversely proportional   (b) directly proportional

(c) equal   (d) uniform

91. The ratio of hoop stress to maximum shear stress is

(a) 2   (b) 3

(c) 4   (d) 6

92. The shear stress at outer surface of hollow circular section is
   (a) Zero
   (b) Maximum
   (c) Minimum
   (d) Can't determine

93. The moment which resists the external bending is called
   (a) Moment of shear
   (b) Tolerating moment
   (c) Moment of resistance
   (d) Maximum bending moment

94. What is the strain energy stored in a body due to gradually applied load?
   (a) sE/V
   (b) sE^2/V
   (c) sV^2/E
   (d) $sV^2/2E$

95. Poisson's ratio is defined as ratio of
   (a) axial strain to transverse strain
   (b) transverse strain to axial strain
   (c) shear strain to axial strain
   (d) axial strain to shear strain

96. The point of contraflexure lies where
   (a) shear force changes sign
   (b) bending moment is zero or changes sign
   (c) shear force is zero
   (d) bending moment is maximum

97. A material of young's modulus and Poisson ratio of unity is subjected to two principal stresses s_1 and s_2 at a point in two-dimensional stress system. The strain energy per unit volume of the material is
   (a) $(s_1^2 + s_2^2 - 2s_1s_2)/2E$
   (b) $(s_1^2 + s_2^2 + 2s_1s_2)/2E$
   (c) $(s_1^2 - s_2^2 - 2s_1s_2)/2E$
   (d) $(s_1^2 - s_2^2 - 2s_1s_2)/2E$

98. What is the ratio of Youngs modulus E to shear modulus G in terms of Poisson ratio?
   (a) $2(1 + m)$
   (b) $2(1 - m)$
   (c) $1/2\,(1 - m)$
   (d) $1/2\,(1 + m)$

99. Hooke's law holds good up to
   (a) Yield point
   (b) Limit of proportionality
   (c) Breaking point
   (d) Elastic limit

100. Which of the following is a spring-controlled governor?
   (a) Hartnell governor
   (b) Hartung governor
   (c) Wilson-Hartnell governor
   (d) all of these

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